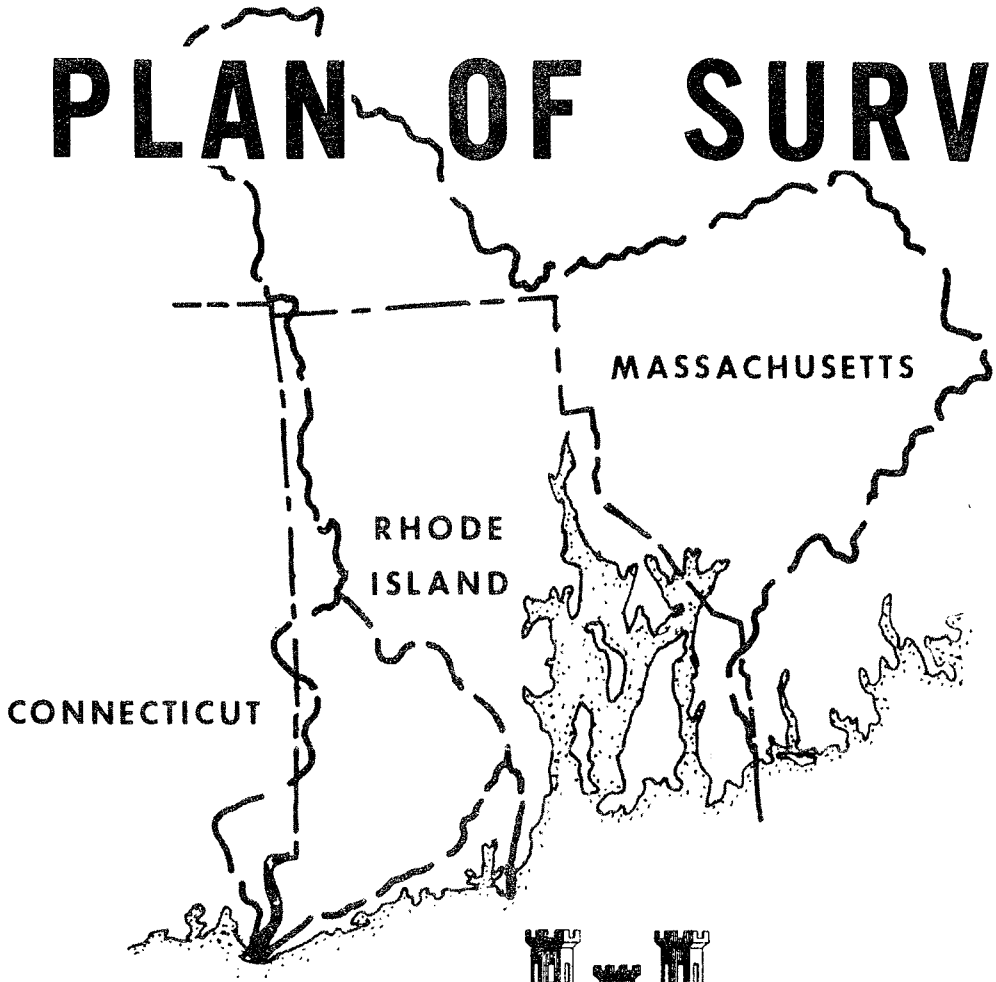
WATER AND RELATED LAND RESOURCES INVESTIGATION

PAWCATUCK RIVER AND NARRAGANSETT BAY DRAINAGE BASINS

PLAN OF SURVEY



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

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WATER AND RELATED LAND RESOURCES INVESTIGATION

PAWCATUCK RIVER AND

NARRAGANSETT BAY DRAINAGE BASINS

MASSACHUSETTS RHODE ISLAND CONNECTICUT

PLAN OF SURVEY

Department of the Army
New England Division, Corps of Engineers
Waltham, Mass.

June 1970

PREFACE

The Plan of Survey presents the procedure to be followed in accomplishing the Pawcatuck River and Narragansett Bay Drainage Basins - Water and Related Land Resources Investigation (PNB), and describes the four major segments of work. Portions of this Plan of Survey will, by reason of continued coordination, communication and findings, be subject to changes as required, most likely on an annual basis.

The PNB Study is referenced as Type III described as being of survey scope to formulate and recommend plans of improvement to resolve the flooding and related problems. It encompasses narrower geographic or analytic scope than Type I (Framework) or Type II (Comprehensive) studies. There is a Type IV category, also, which describes single or special purpose studies. Type III studies are usually undertaken by a single agency, (in this case the Corps of Engineers), for plan or project recommendations, with normal coordination maintained with other Federal agencies, the States, regional planning districts, and local interests as relates to their on-going programs.

Current study programs of major importance to this study include: the Type I, North Atlantic Regional Water Resources Study (NAR), under the direction of the Corps of Engineers; the Type II, Southeastern New England Comprehensive Study (SENE), directed by the New England River Basins Commission; and the Type IV, Northeastern United States Water Supply Study (NEWS) also under the direction of the Corps of Engineers.

The NAR Study is nearing completion with the final report to be submitted in Fiscal Year 1971. This study delineates a broad array of resource needs and problems both by subregion, resource planning area, and hydrologic area. The PNB study area is included within the limits of the NAR study.

The SENE Study has been approved by the Federal Water Resources Council and is scheduled for a 1970 start. The PNB basins represent a large section of the SENE study area.

The NEWS study group, assigned the task of developing conceptual water supply source and conveyance systems to provide adequate supplies in the water short urban centers of the Northeast, has considered the heavily urbanized areas in the PNB study area.

The plan of preservation and development to be prepared by the PNB study group will avail itself of inputs from these other studies and be completely compatible with the plans formulated in these comprehensive and special purpose investigations.

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1. INTRODUCTION

This plan of survey sets forth the general procedures to be followed to develop a plan for water and related land resources for the Pawcatuck River and Narragansett Bay Drainage Basins, Rhode Island, Massachusetts and Connecticut. Orientation and direction are indicated as well as the inter-relationship this survey has with the broad framework study of the entire North Atlantic Region, now nearing completion, and the comprehensive survey of the southeastern New England subregion, soon to be under way.

This study will be closely coordinated with the several resource agencies of the three States. Other Federal agencies, engaged in water and related land resource planning and management, will be consulted and their comments will be reflected in the ensuing plan.

2. AUTHORITY FOR STUDY

RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, ADOPTED 29 MARCH 1968:

> "That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act, approved 13 June 1902, be, and is hereby requested to review the report on Land and Water Resources of the New England-New York Region, transmitted to the President of the United States by the Secretary of the Army on 27 April 1956, and subsequently published as Senate Document Number 14, Eighty-fifth Congress, with a view to determining

in the light of the heavy damages suffered during the storm of March 1968, in southern New England, the advisability of improvements, particularly in the Pawcatuck River Basin, Rhode Island, and in the Narragansett Bay Drainage Basin, Massachusetts and Rhode Island, in the interest of flood control, navigation, water supply, water quality control, recreation, low-flow augmentation and other allied water uses."

Antecedent to Spring 1968 authority was given by a Senate Resolution adopted 8 May 1967 to review the Blackstone River, Massachusetts and Rhode Island in the interest of flood control and allied purposes. Subsequent to the major flood of March 1968, and the 29 March 1968 resolution, five other separate resolutions were adopted by the U. S. Senate and House of Representatives with particular reference to the Pawcatuck River and Narragansett Bay Drainage Basins and to subbasins within the Narragansett Bay Drainage area. The seven outstanding resolutions have been combined in this study.

3. SURVEY OBJECTIVE

The basic objective of the Pawcatuck River-Narragansett Bay Drainage Basins Study is to determine the advisability of improvements for flood control, navigation and other allied purposes to meet present and foreseeable long term needs within the study area.

4. DRAINAGE BASINS DESCRIPTION

The Pawcatuck River Basin is located in southwestern Rhode Island and southeastern Connecticut. It is bounded on the northeast by the Narragansett Bay Drainage Basin; on the northwest by the Thames River Basin; and on the southwest and southeast by the Connecticut and Rhode Island Coastal Areas, respectively. It has a total area of about 300 square miles, of which approximately 240 square miles are situated in Rhode Island and 60 square miles in Connecticut. The Pawcatuck River has a total fall of approximately 90 feet from its headwaters to the sea and is tidal and navigable to Westerly, Rhode Island for a distance of about 5 miles. The lower 9 miles of the river forms the state boundary between Connecticut and Rhode Island.

The Narragansett Bay Drainage Basin comprises all the watershed tributary to Narragansett Bay and the Atlantic Ocean from the Massachusetts-Rhode Island state line, westward to Point Judith, Rhode Island. It is bounded on the southeast, east and northeast by

the Massachusetts Coastal Area; on the north by the Merrimack River Basin, on the west by the Connecticut and Thames River Basins; and on the southwest by the Pawcatuck River Basin and the Rhode Island Coastal Area. The Narragansett Bay Basin drains a total area of about 1,870 square miles of which 1,040 square miles lie in Massachusetts with the remaining 830 square miles in Rhode Island. The three largest river systems draining to the Bay include the Taunton River draining 540 square miles of area entirely within Massachusetts; the Blackstone River draining 540 square miles encompassing portions of south-central Massachusetts and northern Rhode Island; and the Pawtuxet River draining 230 square miles entirely within Rhode Island.

Elevations within the study area extend from sea level along the coast and in tidal inlets to over 1,300 feet above mean sea level in the upper Blackstone River subregion. A listing of drainage areas is included in Table 1, and a Basin map is attached.

In 1965, there were 1,620,000 persons living within the Study Area in all or portions of 106 cities and towns. A breakdown of general information is included in Table 1. Within the study area are the major portions of four (4) Standard Metropolitan Statistical Areas (SMSA's) as defined by the United States Bureau of the Census.

1. Brockton, Massachusetts
2. Fall River, Massachusetts
3. Providence-Pawtucket, Rhode Island-Massachusetts
4. Worcester, Massachusetts

A small peripheral area from the Boston, Massachusetts SMSA is included in the study area. According to a recent release from the Census Bureau, the Brockton SMSA is among the 25 fastest growing in the entire nation and is expected to increase in population by 22% between 1965 and 1975.

The Narragansett Bay area lies in one of the most densely populated regions of the country. The population density of the PNB study area measured 793 persons per square miles in 1965 as compared to slightly over 60 for the nation's contiguous 48 states, and near 50 for the country as a whole. According to 1965 State census figures, over 810,000 people live in the 26 cities and towns situated along the periphery of Narragansett Bay and appended estuaries with 619,000 living in Rhode Island, the remainder in Massachusetts.

TABLE 1

PAWCATUCK RIVER AND NARRAGANSETT BAY DRAINAGE BASINS

GENERAL INFORMATION

DESCRIPTION	CONN.	MASS.	R. I.	TOTAL
Drainage Area (sq. mi.)				
Pawcatuck River	60	0	240	300
Narragansett Bay	0	1,040	830	1,870
Total	60	1,040	1,070	2,170
Total (less tidal waters)	60	1,030	940	2,030
% of State Area	1.2	13.1	88.7	14.7
Population (1,000's)				
1960 Census	7	683	850	1,540
1965 State Census	8(1)	732	880	1,620
% of State Population	0.3	13.6	98.7	18.6
Population Density (persons/sq. mi.)				
Survey Area	140	712	937	793
Statewide	563	682	849	652
Miscellaneous Statistics				
Number of Counties	2	5	5	12
Number of Municipalities	4	64	38	106

(1) Projection derived from figures prepared by the Connecticut Interregional Planning Program - December 1968.

Listed in Table 2 are the 106 cities and towns wholly or partially within the Drainage Basin study area.

TABLE 2

MUNICIPALITIES IN THE DRAINAGE AREA

MASSACHUSETTS

1. Abington
2. Attleboro
3. Auburn
4. Avon
5. Bellingham
6. Berkley
7. Blackstone
8. Boylston
9. Bridgewater
10. Brockton
11. Carver
12. Dighton
13. Douglas
14. East Bridgewater
15. Easton
16. Fall River
17. Foxboro
18. Franklin
19. Freetown
20. Grafton
21. Halifax
22. Hanson
23. Holbrook
24. Holden
25. Hopedale
26. Hopkinton
27. Kingston
28. Lakeville
29. Leicester
30. Mansfield
31. Mendon
32. Middleboro
33. Milford
34. Millbury
35. Millville
36. North Attleboro
37. Northbridge
38. Norton
39. Oxford
40. Paxton
41. Pembroke
42. Plainville
43. Plympton
44. Raynham
45. Rehoboth
46. Rockland
47. Seekonk
48. Sharon
49. Shrewsbury
50. Somerset
51. Stoughton
52. Sutton
53. Swansea
54. Taunton
55. Upton
56. Uxbridge
57. Webster
58. Westboro
59. W. Boylston
60. W. Bridgewater
61. Westport
62. Whitman
63. Worcester
64. Wrentham

CONNECTICUT

1. North Stonington
2. Sterling
3. Stonington
4. Voluntown

TABLE 2 (cont'd.)

RHODE ISLAND

1. Barrington
2. Bristol
3. Burillville
4. Central Falls
5. Charlestown
6. Coventry
7. Cranston
8. Cumberland
9. East Greenwich
10. East Providence
11. Exeter
12. Foster
13. Glocester
14. Hopkinton
15. Jamestown
16. Johnston
17. Lincoln
18. Little Compton
19. Middletown
20. Narragansett
21. Newport
22. North Kingstown
23. North Providence
24. North Smithfield
25. Pawtucket
26. Portsmouth
27. Providence
28. Richmond
29. Scituate
30. Smithfield
31. South Kingstown
32. Tiverton
33. Warren
34. Warwick
35. W. Greenwich
36. W. Warwick
37. Westerly
38. Woonsocket

The study area has a temperate and changeable climate characteristic of its latitude and of New England. Owing to the moderating influence of bays, sounds and the Atlantic Ocean and particularly to the variable movements of high and low pressure systems approaching from the west or southwest, extremes of either hot or cold weather are rarely of long duration. In the winter, coastal storms frequently bring rainfall, in contrast to snow in interior areas. In the summer, cooling relief from hot, humid weather is provided by sea breezes from the south, thunder storms from the west, and cool air from the north. The prevailing winds are northwesterly in the winter and southwesterly in the summer. High winds, heavy rainfall, and abnormally high tides occur with unpredictable frequency. Hurricanes can be expected any time after June and especially during the months of August, September and October.

The average annual temperature of the study area, based on records for the period 1871 to 1954 is approximately 50 degrees F. February, the coldest month, has a mean temperature of 29 degrees F, and July, the warmest month, has a mean temperature of 72 degrees F. Freezing temperatures, which are common from late November through March, occur on an average of 100 to 120 days a year.

The mean annual precipitation over the study area during the 84-year period of record amounts to about 44 inches and is rather evenly distributed throughout the year. Measurable precipitation occurs on an average about 120 to 125 days out of the year. Average monthly rainfall varies between 4.39 inches for August and 3.09 inches for June. Annual snowfall based on 34 years of record averages 34 inches.

5. CURRENT STATUS OF WATER AND RELATED LAND RESOURCE DEVELOPMENT

a. Flood Control Structures for Fresh Water Flood Damage Reduction

Survey reports prepared by the Corps of Engineers after the 1936 and 1938 floods resulted in the authorization in the 1944 Flood Control Act of four flood control projects in the Blackstone River tributary to the Narragansett Bay Drainage Basin. Three of these projects, West Hill Dam and Reservoir and Worcester Diversion Local Protection, both in Massachusetts, and Woonsocket Local Protection in Rhode Island, were constructed after the devastating floods of 1955 at a total cost of $13,000,000 including a non-Federal cost of approximately $1,790,000. The fourth project, Pawtucket Local Protection, was deferred and is currently carried in the inactive category.

The Lower Woonsocket Local Protection Project was authorized by the Flood Control Act of 1960. The project was completed in 1966 at a total estimated cost of $9,150,000 including a non-Federal cost of $2,312,000.

Corps of Engineers flood control constructed projects as noted above in the Blackstone River Sub-basin prevented $8,000,000 in damages in the March 1968 event.

The Flood Control Act of 1941 authorized two projects in the Pawtuxet River Basin, namely, local protection on the North Branch in the Clyde Section of West Warwick, and a diversion project from the main Pawtuxet River at Pontiac in Warwick, south to the Apponaug River and Greenwich Bay. Local support was not provided and the project authorizations expired in 1951.

The major storm of 18-23 March 1968 caused a record flood on the Pawcatuck and Narragansett Bay Basins. At 19 stream gaging stations in the study area the March 1968 storm was considered the maximum flood of record. Particularly, this is true in the Taunton, Pawtuxet and Pawcatuck tributary areas, and on the more southerly tributaries of the Blackstone River Sub-basin.

b. Hurricane or Tidal Flood Damage Reduction

The distribution of recorded hurricane occurrences in the Little Narragansett and Narragansett Bay area, by estimated degree of intensity, is shown in Table 3.

TABLE 3

RECORDED HURRICANE OCCURRENCES
Narragansett Bay Area, R. I. and Mass.

Period	Category			Total
	Severe Tidal Flooding	Moderate Tidal Flooding (*)	Threatened Area	
1635-1700	2	No Record	No Record	2
1701-1800	3	2	2	7
1801-1900	5	8	4	17
1901-1963	3	15	27	45
Total	13	25	33	71

(*) Damage principally from wind and rainfall

Projects to reduce hurricane tidal flooding have been completed at Pawcatuck, Connecticut and Providence, Rhode Island at a total cost of $16,765,000 of which the non-Federal share was $5,030,000. The Narragansett Pier Hurricane Project, authorized in 1962 for hurricane tidal flood protection, beach erosion control and navigation improvement, was not constructed and is now inactive. In the absence of local assurances the authorization for Narragansett Pier will expire in November, 1970. The Point Judith hurricane tidal-flood protection, beach erosion control and navigation improvement authorized in 1962 is currently carried in the inactive category.

c. Flood Plain Reservation and Use

The flood plain consists of lowlands located adjacent to the stream which act as natural reserve areas in times of excess runoff. Damage occurs where man has trespassed on the river. Continuing encroachment on the flood plain tends to offset the gains earned by the flood control dams, floodwalls, dikes and associated improvements. The construction of new developments in flood-prone areas reduces the hydraulic efficiency of river channels. Flood hazards are thereby increased and the effectiveness of existing flood control works is correspondingly diminished. The floods of March 1968 in southeastern New England caused damage to large areas and the flooding damage was particularly noticeable where wetlands, which are considered part of the flood plain, had been filled.

Flood plain information studies are now under way along the Blackstone River for the communities of Lincoln, Cumberland, Pawtucket and Central Falls.

Section 206 of the Flood Control Act approved 14 July 1960 (P. L. 86-645), as amended, authorizes the Secretary of the Army, through the Chief of Engineers, to compile and disseminate information on floods, flood damage potentials, and general criteria for guidance of Federal and non-Federal interests and agencies in the use of flood plain areas. Under this authorization the Corps of Engineers carries out its Flood Plain Management Services program.

Information, guidance, and advice on flood hazards are made available to Federal, State, and local governmental agencies which will permit them to proceed with such planning, engineering studies, construction, and other action as may be necessary for wise use of flood plains. Application of such information and guidance by these agencies is intended to help in planning and regulating the use of flood plain areas to reduce flood hazards and flood damage potential which otherwise could arise from unwise flood plain development.

The program includes preparation of flood plain information reports; provision of technical services and guidance in the interpretation of basic data, preparation of flood plain regulations, and application of concepts such as structural flood-proofing of new and existing buildings; preparation of guides and pamphlets; conduct of related research; and long-range comprehensive flood damage reduction planning. These

activities are being coordinated with related programs of other Federal and State agencies. Guides and pamphlets are distributed for use by State and local governments, private citizens, and Federal agencies in planning and taking action to reduce their flood damages or damage potential.

Starting in 1967, this program has included assistance and guidance not only to State and local agencies but to Federal agencies as well, in accordance with requirements of Executive Order 11296. This Order is concerned with site location of innumerable Federal improvements, disposal of Federal properties in flood hazard areas, and proper consideration of flood hazard in all Federal grant, loan, mortgage insurance, and land use planning programs.

Comprehensive flood damage prevention planning, at all appropriate governmental levels, is the composite and ultimate objective of the Flood Plain Management Services program. It is not a separable activity, but takes place through preparation and dissemination of flood plain information reports, through provision of technical advice and other forms of assistance to persons and governmental entities concerned with flood hazard problems, and through continuing research on means for dealing more effectively with flood problems. The purpose of these activities, taken together, is to encourage and guide the best and safest use possible of flood plain lands for the benefit of the national economy and welfare. The program provides a highly desirable and useful tool in rounding out the national effort in treating flood problems and provides a direct complement to other flood control efforts by the Corps of Engineers.

d. Flood Plain Insurance Program

The Housing and Urban Development Act of 1968, Public Law 90-448, Section XIII of the 90th Congress authorized a program for flood insurance. The purpose is to determine Federal programs which could provide financial assistance to those suffering losses in floods. Under the direction of the U. S. Departm ent of Housing and Urban Development, the Providence-East Providence area is presently under study by the Corps of Engineers. The Providence portion of the study is completed, and the East Providence portion is under way.

e. Shore Protection

The Cliff Walk Shore Protection Project at Newport, Rhode Island, authorized in 1965, is under design by the Corps of Engineers. Local interests are sharing in the cost.

f. Navigation

Narragansett Bay, one of the largest deep-water harbors on the Atlantic Coast, is the seaway to the major ports of Providence and Fall River. The 1968 water-borne commerce throughout the entire bay area amounted to 13.3 million tons and consisted primarily of petroleum and petroleum products. About 9.5 million tons were handled through terminals on the Providence River in 1968 and the average 5-year volume of traffic between 1964 and 1968 measured about 9 million tons. Volume of traffic at Fall River Harbor in 1968 was about 3.5 million tons and the 1964 through 1968 average tonnage was 3.6 million. Less than 2% of the total commerce was handled at smaller ports throughout the balance of the bay.

The existing navigation project on the Providence River is currently being improved providing for a deepened and extended channel at a cost of $18.1 million. Modifications, including deepening of the channels and extensive bridge work, were authorized for Fall River Harbor in 1968 and this new work now under design is estimated to cost $12 million.

Naval vessels using Narragansett Bay include all types of modern fighting ships and support craft which comprise the Atlantic Fleet.

Navigation in the Pawcatuck River Basin is confined to Little Narragansett Bay and the tidal reaches of the river for a distance of about five miles. Up until 1963 the average annual commerce in this area amounted to about 15,000 tons; however, in 1963 the volume had dropped to 2,200 tons and records of water-borne commerce have not been compiled since that date.

The waters of the PNB study area are used extensively, especially during the summer months, by thousands of small fishing and recreational craft ranging in size from small motor boats to large craft of 100 feet or more in length and up to 7 feet in draft. In recent years, the

number of recreational craft, both sail and motor, has increased immensely. The Corps of Engineers has constructed safe entrance channels, major access channels, maneuvering and turning basins and anchorages in support of recreational boating and for fishing and other small craft within the study area.

Overall, seventeen Federally sponsored navigation and harbor projects have been constructed or are authorized in the study area representing a total Federal first cost exceeding $38 million. These seventeen projects are listed in Table 4.

TABLE 4

NAVIGATION PROJECTS - PAWCATUCK RIVER AND NARRAGANSETT BAY DRAINAGE BASINS

Project	Status
Apponaug Cove, Warwick, R. I.	Completed
Bristol Harbor, Bristol, R. I.	Authorized
Bullocks Point Cove, East Providence-Barrington, R. I.	Completed
Fall River Harbor, R. I. and Mass.	Authorized
Greenwich Bay, Warwick, R. I.	Completed
Harbor at Coasters Harbor Island, Newport, R. I.	Completed
Newport Harbor, R. I.	Completed
Pawcatuck River, R. I. and Conn.	Completed
Pawtuxet Cove, Cranston-Warwick, R. I.	Completed
Potowomut River, North Kingstown-Warwick, R. I.	Completed
Providence River and Harbor, R. I.	Under Constr.
Sakonnet Harbor, Little Compton, R. I.	Completed
Sakonnet River, Tiverton-Portsmouth, R. I.	Completed
Seekonk River, East Providence-Pawtucket, R. I.	Completed
Warren River, Bristol, R. I.	Completed
Warwick Cove, Warwick, R. I.	Completed
Wickford Harbor, East Greenwich-North Kingstown, R. I.	Completed

g. Water Quality

As may have been anticipated, the present condition of water quality throughout the Pawcatuck River and Narragansett Bay Drainage Basins is varied according to use and degree of treatment received by discharges to it. The entire area has been classified by the three States

and a large portion of the stream reaches, as now classified, represent an upgrading from the conditions as they exist. A schedule for compliance with the classification was approved by the Federal Water Quality Administration and some planning and actual construction of conveyance devices and treatment facilities is under way.

6. DESIRES OF LOCAL INTERESTS

The Pawcatuck River and Narragansett Bay Drainage Basins Study was authorized by the Congress of the United States as a result of the widespread and severe flooding occasioned by the heavy rainfall and simultaneous snowmelt in March of 1968. The strong and concerted voices of local interests, within the areas affected by flooding, delineated some of the outstanding problems and reinforced need for the study.

Several specific requests for action were directed to the Division Engineer from those who had suffered heavy damages.

Four public hearings were held within the subject area in May of 1969. These hearings were attended by over two-hundred and fifty persons; sixty-seven of whom pointed to a specific resource problem, indicated a present or future need in the area or offered general support for the investigation. Fifty-one of those speaking were responsible officials of Federal, State or municipal governments and their agencies.

In the period since the initial hearings additional requests for Federal assistance in solving specific flood problems have come to the Division Engineer. These requests are also being considered under other existing authorities available to the Corps of Engineers. Some of these have been found to be eligible for immediate study as a small project under Section 205 of the Flood Control Act of 1948, as amended. All of these flood problems will be considered in the formulation of alternative plans in this Pawcatuck River and Narragansett Bay Drainage Basins Study.

In order to fully update the total inventory of flood problem locations, letters requesting such information have been mailed to responsible local officials. In this manner areas flooded during more recent high water periods will also be covered. This method of information seeking will be repeated during the course of the study and as necessary.

Inclusion of flood control as a project purpose has been requested by state agency officials who are planning water supply storage reservoirs to meet future needs. These requests will be considered as a part of the total planning effort.

7. OTHER ON-GOING WATER RESOURCE STUDIES

a. General. The broad scope NAR framework study is being prepared by a coordinating committee of Federal and State membership with the working chair agency being the North Atlantic Division, Corps of Engineers. The comprehensive SENE study will be directed by the New England River Basins Commission with the assistance of Federal and State agencies.

b. The Water Resources Commission of the Commonwealth of Massachusetts has initiated a study toward formulation of an overall State Water and Related Land Resources Plan. The Commission will be assisted in this planning effort by the United States Department of Agriculture. The Commission is also active in coordinating the water resources planning and development undertaken by other State agencies.

c. The Water Resources Coordinating Board of the State of Rhode Island is engaged in planning activities leading toward coordinated plans for preservation and development of the water resources of that State.

d. The Water Resources Commission of the State of Connecticut coordinates water resources planning activities for the State.

e. The New England River Basins Commission is engaged in the coordination of the many member agencies programs to help assure the adequacy of the regions water and related land resources plans. In this regard they have not only initiated action toward a comprehensive study of water and related land resources for Southeastern New England, (SENE), but also recognize the need to formulate a plan for enhancement, development and preservation of the coastal zone in the region, and have set into motion a power environment program essentially to evaluate siting of proposed power plants.

f. The Department of Agriculture, through its three locally active agencies; the Soil Conservation Service, the Economic Research

Service and the Forest Service, is engaged in water resources planning in conjunction with both the States and the county-level Soil Conservation Districts. In particular, it is assisting the Commonwealth of Massachusetts with its overall State Water and Related Land Resources Plan.

g. The Department of the Interior, Federal Water Quality Administration, is active in screening applicants for sewage treatment plant construction grants. Interstate and intrastate streams and coastal zones within the study area have been classified as to proposed water quality.

h. Other Federal agencies, such as the United States Geological Survey, the Bureau of Outdoor Recreation, the United States Bureau of Sports Fisheries and Wildlife, the Weather Bureau and the Public Health Service, have continuing programs in the water and related land resources field which inventory, provide surveillance to or furnish matching funds, grants-in-aid, or consulting services to the States and their subdivisions.

i. The five regional planning districts within the study area include:

(1) Central Massachusetts Regional Planning Commission,

(2) Metropolitan Area Planning Council,

(3) Old Colony Planning Council,

(4) Southeastern Massachusetts Regional Planning Commission, and

(5) Rhode Island Statewide Comprehensive Transportation and Land Use Planning Program

These planning agencies, working with funds largely provided by the Federal Department of Housing and Urban Development, have been engaged in developing regional plans for water supply, sewage disposal and land use within a projective time reference.

j. Municipally oriented conservation commissions have been formed throughout the three States included in the study area. Many of these commissions have or are developing viable programs geared to the acquisition of natural areas, through gifts and purchase, and the encouragement of adequate flood plain zoning.

8. GENERAL AND PLANNING CRITERIA

The abatement of flood damage is the primary consideration of this study but all water resource uses will be considered in conjunction with flood control to produce optimum water resource development where possible. The philosophies of multiple use and multiple objectives embodied in S-97* will be utilized. Consideration is to be given in evaluating the economics of conflicting and/or competitive uses of land and water resources.

Attention will be given to minimization of future flood control damage through the encouragement of proper flood plain management practices and land uses, particularly as relates to flood plains. In those instances where flood plains are already developed then the use of flood proofing, the establishment of encroachment lines will be considered as primary tools in controlling future flood losses. Where municipalities have vacant flood plains they will be encouraged to embody these areas into open spaces, green belt and other recreational areas of activity such as municipal parks. The public acquisition of such lands will also be suggested.

In the course of the study, when areas are found to possess high environmental values they will be identified and recommendations will be made, where possible, toward maintenance of these values. As implementation of these recommendations may not come under the purview of the Corps of Engineers, programs of other Federal, State or private agencies engaged in land husbandry will be suggested. In other areas where existing environmental values may be lower but with potential for improvement, suitable recommendations will be considered. In each area considered for potential flood control and allied purpose development the environmental impact of the proposed project will be considered and the cost of mitigation measures will be weighed for possible inclusion in plan formulation.

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*U. S. Senate Document No. 97, 87th Congress, 2nd Session: Water Resource Policy Guidelines.

Each of the subbasins feeding Narragansett Bay comprise independent river systems. The Pawcatuck River is also a separate and independent river system. Each river system will be studied separately from each other in all physical attributes, and natural characteristics inventoried. These natural zones of supply will be evaluated against the areas' needs.

Initially, the study will guide itself upon those thoughts and desires presented at the four public meetings. However, extensive consultation with state and local units will likely alter this plan strategically. The current priority list is as follows:

(1) Taunton River Watershed,

(2) Providence River Group,
(which includes the Ten Mile, Blackstone, Moshassuck and Woonasquatucket River tributary areas),

(3) Pawtuxet River Watershed,

(4) Pawcatuck River Watershed,

(5) and the Narragansett Bay Local Drainage,
(which includes all minor streams not mentioned above).

The survey has been broken into four sequential and complementary segments. These segments are: history and inventory, needs and potentials, plan formulation and plan presentation. The segments of work as applied to the five study areas noted above will overlap with differing work assignments within each subarea under way concurrently.

The final phase of the study, completion of the report, will include all subareas simultaneously. Interim reports recommending solutions to flood problems needing immediate attention will be prepared as required and found feasible, and as approved by the Office of the Chief of Engineers, Washington, D. C.

a. History and Inventory.

Four public hearings were held in May 1969. The stenographic accounts of these hearings have been reviewed and condensed into a Digest of Public Hearings which will be distributed as part of the on-going coordination. Additionally, public contacts of long standing have been further supplemented with new contacts throughout the study area. Public communication will be continued and augmented during the course of the study with local officials, conservation commissions, leagues of women voters, and private groups interested in matters of conservation and wise use of natural resources.

As a result of the public hearings and other meetings, preliminary needs have been established for the study area. These needs will be revised, as necessary, as the study progresses.

An information pamphlet was prepared and given wide distribution at the time of the four public hearings. This hand-out is of continuing value as a description of the study area and gives insight as to study objectives.

Natural parameters of tributary streams as related to flood producing characteristics within the three highest priority sub-areas have been assembled. A study of generalized hydrologic relations and water resource capability has been initiated.

The economic base as prepared for the North Atlantic Regional Water Resources Study will be used as a common reference during the preliminary analysis period.

An analysis of the flood prone areas and damages sustained from flooding will be continued along with a review of existing land use.

Maximum utilization will be made of all existing material such as the report of the New England-New York Inter-Agency Committee (NENYIAC), and reports of other Federal, State and municipal agencies with particular emphasis upon those reports of the several Regional Planning Groups within the study area. A complete inventory of this available data has been initiated to reduce duplication of

effort. Development of new primary data will be minimized and screening of alternative measures to begin with the second major segment of work, needs and potentials, will be accomplished to the maximum extent practicable by use of past studies and records, reconnaissance surveys and consultations with Federal and State agencies.

b. Needs and Potentials.

An evaluation of resource needs and problems as related to flood control and allied purposes, as well as a determination of alternative potentials comprise the second major phase.

Needs will be referenced to an economic base study analysis prepared through the disaggregation of the economic base data provided through NAR and in combination with the projective economic surveys under continual development by other regional planning agencies located within the authorized study area.

The disaggregation of economic data will begin by breaking the Pawcatuck-Narragansett study area out of the Water Resource Planning Area 6 as delineated by the North Atlantic Regional Framework Study. The study area will be separated into the five regional planning districts and further reduced into manageable sector study units which are economically associated and as closely connected hydrologically as possible to natural drainage characteristics. The result of this disaggregation will be to localize those subregions where present or future resource development needs might best be considered in conjunction with solutions to pending flood control problems.

The compilation of information with regard to flood losses, experienced and potential, screenings for local protection projects and possible reservoir sites, together with identification of those natural flood-retention areas, will comprise the major part of this segment of work. Site and local protection screening will include hydrologic and hydraulic analyses, foundation and material investigations, limited topographic mapping, review of lands and project design planning and cost estimating. Economic benefit analyses will also be accomplished. The screening will likely produce an array of feasible site potentials geared to reduce flood damages.

From such structural and non-structural potentials will be drawn the alternative solutions from which the plan formulation phase may select plans of development.

An evaluation of other resource use at these screened potentials will be made. All compatible and economically desirable resource uses will be included where feasible. Impact studies with regard to the possible disruptive effect of resource development upon other parameters will be undertaken. Mitigation measures will be included as part of site planning.

The intensive urbanization found in the headwaters, as well as downstream reaches of the hydrologic subareas, is a factor of considerable importance, particularly when flood damage reduction is the primary objective of the planning effort. Recent economic and demographic indicators conclude that the urbanizing forces are stronger now than in the recent past. The base for these urban growth activities lies in the several older industrial centers primarily developed prior to the turn of the twentieth century.

Urbanizing developments are crossing municipal boundaries and are physically and economically linking previously unrelated areas. The effects of adding urban increments to older major drainage networks is disruptive and potentially catastrophic as relates to flooding.

c. Plan Formulation.

The flood control study will prepare a plan of development designed to eliminate or substantially reduce existing flood damage levels, and to propose methods to minimize the development of new and additional damage zones. The plan formulation segment is the key activity leading toward that acceptable plan of development.

From the array of structural and non-structural measures screened during the needs and potential segment, and through a series of discussions with local, State and Federal interests, these measures will be grouped in alternative plans. After consultation with State and local officials throughout the three state areas the most economically and politically feasible ones will be chosen. The plans chosen must be reasonably acceptable to a wide range of public and private interests; they should tend to maximize net benefits from resource uses, taken collectively; and they should be among the more

feasible plans economically, as well as tend toward meeting other objectives.

d. Plan Presentation.

The fourth segment will conclude the study effort and the plan as formulated in segment three, along with the most likely alternatives, will be packaged as a report. Supportive information will be packaged as appendices to the main report.

Informational meetings will be held about every six months to display the plans and officially receive comment with specific reference to the proposed measures being formulated. Public hearings will be held prior to submission of interim reports.

All responsible comment from citizens groups and other interested parties stemming from the meetings and hearings or arriving by letter will be given consideration and the plans adjusted as necessary.

The formulated plan will be given wide circulation for official review.

The report and its appendices will be printed and distributed and submitted to Congress following its review and approval by the Board of Engineers for Rivers and Harbors and the Office of the Chief of Engineers.

9. COORDINATION

Each phase of this study will be fully coordinated with other Federal, State, regional and local agencies engaged in planning or development of water resources within the study area. Coordination with private groups will accrue through the use of a public information program.

10. PROPOSED REPORT OUTLINE

SYLLABUS

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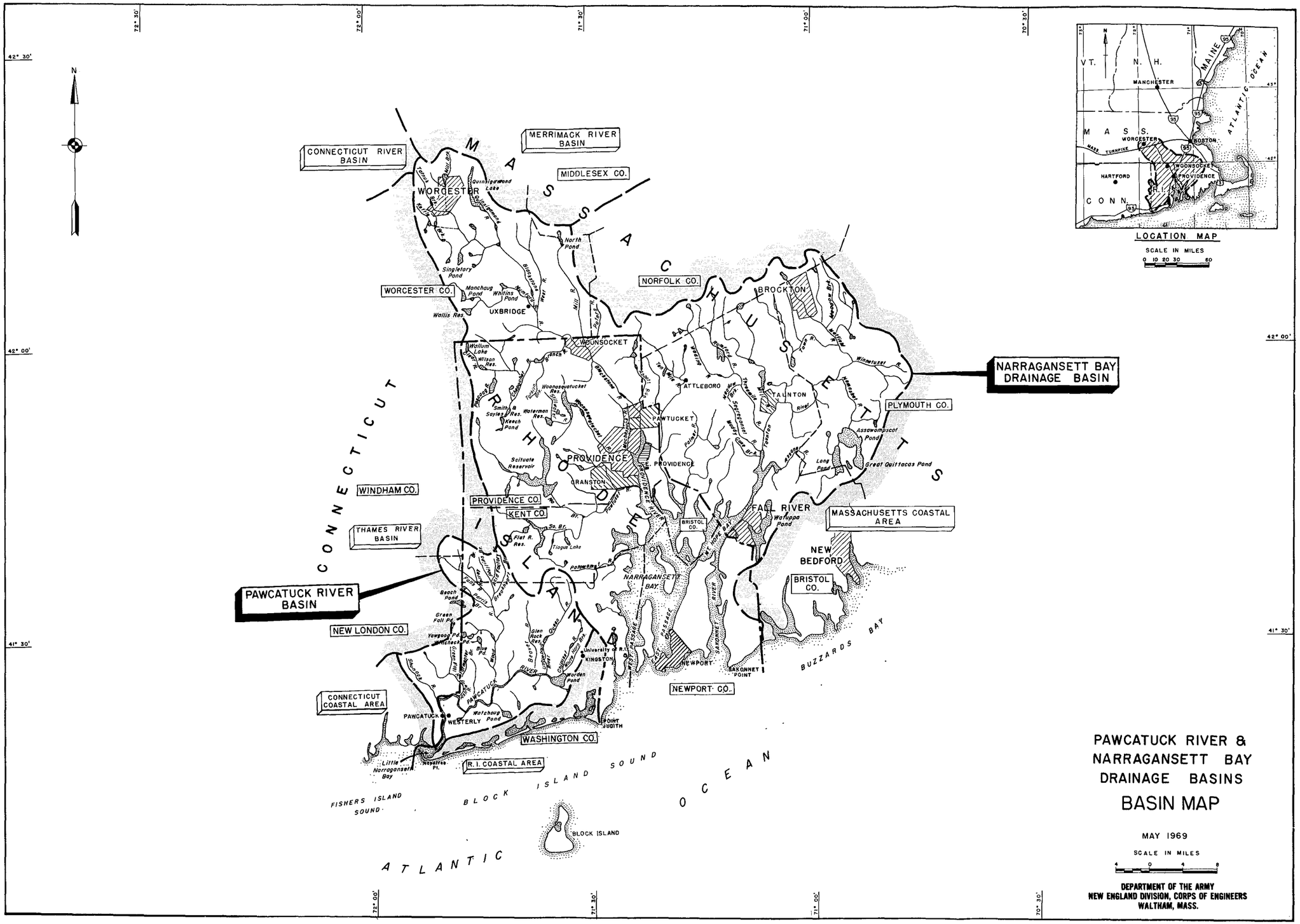

PAWCATUCK RIVER & NARRAGANSETT BAY DRAINAGE BASINS

BASIN MAP

MAY 1969

SCALE IN MILES

4 0 4 8

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

WATER AND RELATED LAND RESOURCES INVESTIGATION

PAWCATUCK RIVER AND NARRAGANSETT BAY DRAINAGE BASINS

ATTACHMENT TO PLAN OF SURVEY
SCHEDULE OF WORK AND BUDGETARY DATA

JUNE 1970

REFERENCE ER 11-2-101, WHICH STATES THAT: BUDGETARY INFORMATION IS NOT TO BE RELEASED OUTSIDE THE DEPARTMENT OF THE ARMY.

SCHEDULE OF WORK

I. GENERAL

1. The preparation of budgetary data for the Pawcatuck River and Narragansett Bay Survey (PNB) is predicated upon the estimated amount of money needed to complete the work items considered necessary for a Type III Study. This budget was prepared with full knowledge of and in complete coordination with the budget as prepared for the SENE Type II Comprehensive Study. There will be no overlap of study effort in the Corps of Engineers between these two undertakings. The New England Division's input to the SENE Study will include all specifically generated data, plan formulations and associated materials comprising the PNB Survey. However, there are many resource values not covered in the Type III Survey which will need coverage by the comprehensive study.

2. The NEWS Study has identified areas of future water supply deficit within the PNB Survey area. Every effort will be taken to incorporate future needs relating to water supply in resolving flood problems.

3. Although the PNB Survey is primarily for flood control, the nature of public reactance to single-purpose solutions today has pointed the Corps of Engineers to consider the multiple objectives of Environmental Quality and Regional Development as well as the National Efficiency objective. The Social Well-being objective is also of growing importance. These multiple objective considerations make resource allocation imperative and generally inhibit the development of single-purpose solutions in formulationg survey output. The cost of preparing plans of development of survey scope has multipled in hand with the multiple objective considerations.

4. The tentative budget submitted with this attachment to the plan of survey is shown in Table A-1. The total $1,600,000, as shown, is predicated upon and complementary to the budget submission for the SENE Study.

II. TENTATIVE SCHEDULE: FY 1971

1. The Tentative Schedule of work is based on the assumption that the allocation of funds for general investigations will remain restrictive during Fiscal Year 1971. Under this assumption, the amount included in the President's FY-71 Budget of $70,000 is considered.

TABLE A-1

A-2

STUDY COST ESTIMATE (PB-6)

APPROPRIATION TITLE: **General Investigations** 96 x 3121

APPROPRIATION CATEGORY: Surveys

APPROPRIATION CLASS: Flood Control Studies

NAME OF STUDY: Pawcatuck River and Narragansett Bay Drainage Basins

LOCATION: Conn., Mass. and R. I.

LINE NO	UNIFORM COST CLASSIFICATION	FEATURE	CURRENT COST ESTIMATE $1,000's	PREVIOUS COST ESTIMATE	REMARKS
	(1)	(2)	(3)	(4)	(5)
1	.1	Preliminary Planning & Public Contact	$ 136		
2	.2	Hydrologic Studies	194		
3	.3	Surveying & Mapping	58		
4	.4	Materials & Foundations Investigations	162		
5	.5	Stream Regulation Studies	23		
6	.6	Design & Cost Estimates	451		
7	.7	Economic Studies	232		
8	.8	Real Estate Studies	23		
9	.9	Special Studies	-		
10	.10	Preparation of Report	57		
11	.11	Supervision & Administration	264		
12					
13	Total		$1,600		
14					
15					
16					

DATE PREPARED	DIVISION	DISTRICT	REGION	BASIN	PAGE
May 1970	New England		NAR	Area 9-b	1 OF 1

ENG FORM 2204 JAN 69 REPLACES EDITION OF 1 JUN 53, WHICH IS OBSOLETE. *(ER 11-2-101)*

GPO 1969 O—329-296

2. The funds will be used to extend the body of generalized hydrologic knowledge and to enlarge the information on the water resource capability and water resources flood control and navigation needs of the study area. The assemblage of natural parameters of the larger streams entering Narragansett Bay and in the Pawcatuck River tributary area will be completed.

3. A detailed analysis of the urban and suburban flood plains will begin in the highest priority study subareas. The existing land use will be examined and will be compared with the preliminary flood damage information. The approximately 110 miles of main stem and major tributary streams which are in urbanized areas, and the 90 miles in a condition of suburban development will form the base reaches for initiation, during this fiscal year, of a study of the particular flood plain attributes that encourage, inhibit or preclude either management, (a non-structural device), direct local protection, (a structural device), or indirect protection through upstream storage, (a structural device), of the affected flood plains. This flood plain analysis, to be carried to conclusion in succeeding fiscal years throughout the study area, will measure a series of parameters in each urban and suburban river reach. These parameters will include the following:

a. topography of lands, in and immediately adjacent to the plain,

b. damage density,

c. the stage of existing development,

d. the attitude of the local citizenry,

e. the relative strength of the existing institutional arrangement,

f. and the visual or cultural effect of the damage reduction measure.

Each of the parameters will be weighted toward either a management or protection solution to the flood problem. The cumulative result of these weightings in each reach will then be compared with the local flood history of the individual damage reach to fully determine the total effectiveness of each device.

4. Development trends gleaned from the economic base study, simultaneously under preparation, will give further evidence as to those flood plains where future growth is likely to occur causing such lands to be under severe competitive pressures for other uses.

5. Field and office studies of local protection and reservoir site potentials will occur concurrent with the detailed flood plain study as well as analysis of natural flood retention areas in the highest priority subarea. Flood frequency and associated benefit-loss study in damage reaches will begin in FY-1972. The correlation of efforts toward both strucutral and non-structural solutions to flood damage problems and needs will be closely watched to determine the most desirable measure or measures for each reach or subreach.

6. Environmental considerations will pervade every phase of this survey. Every attempt will be made to preserve worthy natural values and environmental enhancement will be utilized where possible and desirable.

7. To assist in the public information needs of the study area's population, the master mailing list as prepared for the initial public hearings will be updated and revised as required. Informational meetings, for the benefit of officials and other local interests such as the municipal conservation commissions and semi-private groups as the League of Women Voters, will be held. Coordination with other Federal agencies, pertinent State agencies, and regional planning officials will continue.

III. TENTATIVE SCHEDULE: FY-1972

1. The basic assumption in this schedule of work was that the allocation of funds for general investigations will allow for wider use of other technical skills available at the New England Division office at this stage of the study. This broader study base will include increased use of hydrologic specialty skills and environmentalists. Center-line profiles will be surveyed. Geologic and materials field reconnaissance and preliminary real estate studies will be initiated. Capability exists for efficient utilization of $340,000 during FY-1972.

2. Hydrologic studies will continue with preparation of design floods in those areas tributary to heavy damage zones. These studies will be predicated upon a flood frequency analysis of the subject areas. In the highest priority Taunton River tributary area, intense urbanization forces are presently at work in the extreme

headwater region. The high growth Standard Metropolitan Statistical Area (SMSA) centered on Brockton, Mass., and the southward expansion from the Boston SMSA is altering the historic precipitation-run-off relationships in the Town and Matfield Rivers which join to form the Taunton River in Bridgewater, Mass. and in the Mill River, tributary to the Taunton River. It is predicted that this urbanization will continue and accelerate in the foreseeable future.

With regard to the identification of local protection and reservoir site potentials, certain hydraulic decisions will be needed for comparative purposes. Storage yield relationships will be made when reservoir potentials appear suitable for multiple-use. Refinement of project estimates will also follow.

The large swampy center section of the Taunton River tributary area has been dissected in very recent years by two major, limited-access highways. These highways may have removed significant, natural flood retention areas from effective use by isolating them hydrologically from run-off contributing areas. In addition, economic spin-off from the new access provided by these high speed highways will place enlarging demands upon the available resource base. Another similar highway is now under construction in the southern reaches of the subbasin and an extension of one mentioned above is planned for early construction.

3. In April of 1970 the regular decennial census of the United States was taken by the Bureau of the Census. Reports stemming from this undertaking will begin to become available during Fiscal Year 1971. These reports will be invaluable in the updating of demographic and economic data. The economic base preparation will involve justification of projective data with the results of the 1970 census.

The disaggregation of economic data from the economic base as provided in the NAR Study will be coordinated with the projective economic surveys developed by the five regional planning districts and as further delineated by the city and town monographs prepared by State departments of economic development.

The preparation of the economic base for the Pawcatuck River and Narragansett Bay Drainage Basins Study will be well under way with completion of the base study set for this fiscal year.

4. Detailed flood damage surveys will begin in FY-72. These are necessary since most recent flood loss information has come from newspaper reports.

5. Preparation of stage-damage and damage-frequency relationships will commence in the wake of the flood damage surveys.

6. The detailed analysis of the urban and suburban flood plains as described under the FY-71 schedule of work would proceed more rapidly. The results of the flood damage surveys will be used, as available, to further guide this flood plain study. Flood plain studies in subareas, other than the Taunton River subarea, will be started.

7. The screening of the basins for local protection and reservoir site potentials will be nearly completed and will include limited topographic survey, some foundation and material analysis and preliminary real estate studies. Preliminary benefit analysis will be provided with a view toward eliminating sites which are not feasible or economically justifiable.

8. Significant in the direction of the study effort will be a broadened public information program. Study funds will be available to prepare display material and informative "handouts" for use in localized evening meetings with interested groups. Increased attempts will be made to address potential alternatives directly to interested groups at the lowest local level. Informal meetings should provide efficient feedback of information in the way of local response to our planning effort while the study effort is in progress.

IV. PLANNING SCHEDULES: FY-1973

I. GENERAL

The planning schedule for FY-73 will be dependent upon appropriations. Consideration of the tentative schedule is found in the following paragraphs. A general picture of the major study segments would include the following:

a. Except for an annaul update which would account for new or changing events the resource inventory segment of work would be substantially concluded with the end of FY-71 and this check point will have been achieved.

b. The needs and potential segment of work would be under way and is scheduled for completion during FY-73 and this check point will be reached.

c. The plan formulation stage will get under way in July of 1972.

d. The plan presentation segment will not be under way during FY-73.

2. During FY-73 the final portion of the development for the needs and potentials segment will be accomplished.

a. Hydrologic studies including design flood synthesis in those areas tributary to heavy damage zones will be concluded and hydraulic analyses will be prepared at identified site potentials.

b. Flood damage surveys will be completed in all zones of known and significant flood loss.

c. Stage-damage and damage-frequency relationships will be prepared in correlation with site potentials.

d. Site screening for local protection and reservoir potentials will be completed and each site will be given an economic and an environmental ranking.

e. Natural flood retention areas will be examined with a view toward inventorying those special characteristics which might enable the plan formulation segment to develop a priority listing of such areas for eventual public acquisition. The special characteristics would include an inventory of other potential resources use or management.

f. The detailed analysis of the basins flood plains will continue and will be completed. The results of the flood damage surveys will be used, as available, to further guide this study.

g. A start will be made toward classifying the flood control and allied needs as they relate to the multiple objectives of national income, regional development and environmental quality.

h. The economic base will be refined only as necessary for use in projecting needs and problems within the study area.

3. The plan formulation will get under way and attainable goals will be established in each resource use applicable to this survey.

a. Development of alternative plans will be initiated in each subbasin area. These plans, although geared primarily to flood damage reduction, will include complementary formulation for allied resource use.

b. Coordination with other Federal and State agencies will continue and the public information program will intensify on the local level.

V. PLANNING SCHEDULE: BEYOND FY-1973

In meeting the array of needs as determined by the study and making these compatible with the multiple objectives as set forth in the comprehensive framework study (NAR) which is scheduled for completion in FY-71, the PNB Study schedule will extend for two years beyond FY-73. A complete listing of study work items and their cost is included in Table A-2 and a tentative survey schedule is shown in Table A-3. A bar graph indicating the sequence of these items is attached.

TABLE A-2
SURVEY WORK ITEMS
PART I RESOURCE INVENTORY

ITEM NO.	COST ACCOUNT NO.	WORK ITEM	UNIT OF WORK	UNIT COST $ [1/]	QUANTITY	AMOUNT $	BAR IDENTIFICATION LETTER
1	.1	Establish Coordination for Needs & Benefits	MD	95	12	1,140	A
2	.1	Develop Preliminary Water Resources Needs & Benefits	MD	90	100	9,000	A
3	.1	Coordinate with Federal Agencies	MD	90	30	2,700	B
4	.1	Coordinate with State & Local Interests	MD	90	75	6,750	C
5	.1	Information Bulletins	MD	95	60	5,700	D
6	.1	Arrangements for Initial Public Hearings	MD	95	10	950	E
7	.1	Initial Public Hearings	MD	95	40	3,800	E
8	.7	Basic Economic Disaggregation from Existing Material	MD	90	200	18,000	S

1/ Includes 15% Contingency Allowance
MD = Man Days

TABLE A-2
SURVEY WORK ITEMS
PART I RESOURCE INVENTORY

ITEM NO.	COST ACCOUNT NO.	WORK ITEM	UNIT OF WORK	UNIT COST $ [1/]	QUANTITY	AMOUNT $	BAR IDENTIFICATION LETTER
9	.2	Water Resource Capability & Generalized Hydrology	MD	90	500	45,000	F
10	.6	Planning Reconnaissance	MD	90	420	37,800	K
11	.4	Foundation and Materials Reconnaissance	MD	90	110	9,900	I
12	.1	Continuing Public Information Program	MD	95	180	17,100	C
13	.1	Continuing Agencies Coordination at all Levels	MD	90	60	5,400	B


RECONNAISSANCE CHECKPOINT

1/ Includes 15% Contingency Allowance
MD = Man Days

TABLE A-2
SURVEY WORK ITEMS
PART II NEEDS AND POTENTIALS

ITEM NO.	COST ACCOUNT NO.	WORK ITEM	UNIT OF WORK	UNIT COST $	QUANTITY 1/	AMOUNT $	BAR IDENTIFICATION LETTER
14	.2	Site Oriented Hydrologic Planning	MD	90	300	27,000	G
15	.6	Site Screening	MD	90	600	54,000	K
16	.7	Economic Survey: Review & Update Flood Loss Information	MD	90	400	36,000	T
17	.4	Subsurface Investigation	CD	600	120	72,000	I
18	.3	Center-Line Profiles	CD	320	62	19,840	H
19	.5	Stream Regulation Studies	MD	90	60	5,400	J
20	.7	Justify Economic Base w/1970 Federal Census	MD	90	130	11,700	S
21	.7	Benefit Analysis	MD	90	120	10,800	U
22	.8	Preliminary Real Estate Studies	MD	90	55	4,950	V

1/ Includes 15% Contingency Allowance
MD = Man Days
CD = Crew Days

TABLE A-2
SURVEY WORK ITEMS
PART II NEEDS AND POTENTIALS

ITEM NO.	COST ACCOUNT NO.	WORK ITEMS	UNIT OF WORK	UNIT COST $ [1/]	QUANTITY	AMOUNT $	BAR IDENTIFICATION LETTER
23	.6	Cost Analysis	MD	90	320	28,800	L
24	.1	Continuing Public Information Program	MD	95	180	17,100	C
25	.1	Continuing Agency Coordination at all Levels	MD	90	60	5,400	B
26	.6	Plan Formulation	MD	90	60	5,400	L
27	.7	Flood Damage Survey	MD	90	900	81,000	T


NEEDS CHECKPOINT

1/ Includes 15% Contingency Allowance
MD = Man Days

TABLE A-2
SURVEY WORK ITEMS
PART III PLAN FORMULATION

ITEM NO.	COST ACCOUNT NO.	WORK ITEM	UNIT OF WORK	UNIT COST $ [1/]	QUANTITY	AMOUNT $	BAR IDENTIFICATION LETTER
28	.7	Economic Base Report	MD	90	260	23,400	S
29	.2	Hydrologic & Hydraulic Design	MD	90	900	81,000	G
30	.3	River Channel & Flood Profiles	CD	320	55	17,600	H
31	.3	Topographic Surveys	CD	320	65	20,800	H
32	.6	Site Screening	MD	90	1300	117,000	K
33	.1	Continuing Public Information Program	MD	95	180	17,100	C
34	.1	Continue Agencies Coordination at all Levels	MD	90	60	5,400	B
35	.4	Subsurface Investigation	CD	600	100	60,000	I
36	.5	Stream Regulation Studies	MD	90	190	17,100	J

1/ Includes 15% Contingency Allowance
MD = Man Days
CD = Crew Days

TABLE A-2
SURVEY WORK ITEMS
PART III PLAN FORMULATION

ITEM NO.	COST ACCOUNT NO.	WORK ITEM	UNIT OF WORK	UNIT COST $ 1/	QUANTITY	AMOUNT $	BAR IDENTIFICATION LETTER
37	.7	Benefit Analysis	MD	90	220	19,800	U
38	.8	Real Estate Reports	MD	90	200	18,000	V
39	.6	Cost Analysis	MD	90	220	19,800	L
40	.1	Continuing Public Information Program	MD	95	200	19,000	C
41	.1	Continue Agencies Coordination at all Levels	MD	90	60	5,400	B
42	.6	Water Supply Complement	MD	90	320	28,800	M
43	.6	Water Quality Considerations	MD	90	170	15,300	N
44	.6	Fish and Wildlife Study	MD	90	80	7,200	O
45	.6	Recreation Complement	MD	90	445	40,050	P
46	.6	Navigation & Harbors	MD	90	180	16,200	Q

1/ Includes 15% Contingency Allowance
MD = Man Days

TABLE A-2
SURVEY WORK ITEMS
PART III PLAN FORMULATION

ITEM NO.	COST ACCOUNT NO.	WORK ITEM	UNIT OF WORK	UNIT COST $ 1/	QUANTITY	AMOUNT $	BAR IDENTIFICATION LETTER
47	.6	Other Transportation as Related Formulation	MD	90	80	7,200	R
48	.6	Impact Reports	MD	90	20	1,800	K
49	.6	Plan Formulation	MD	90	445	40,050	L

ALTERNATIVE PLANS CHECKPOINT

TABLE A-2
SURVEY WORK ITEMS
PART IV PLAN PRESENTATION

ITEM NO.	COST ACCOUNT NO.	WORK ITEM	UNIT OF WORK	UNIT COST $ 1/	QUANTITY	AMOUNT $	BAR IDENTIFICATION LETTER
50	.10	Preliminary Report	MD	90	60	5,400	W
51	.10	Prepare Hearing Brochure	MD	90	115	10,350	X
52	.1	Preparations for Public Hearings	MD	95	60	5,700	E
53	.1	Final Public Hearings	MD	95	30	2,850	E
54	.2	Hydrologic Engineering Report	MD	90	460	41,400	F
55	.4	Foundations & Materials Report	MD	90	220	19,800	I
56	.6	Finalized Estimates	MD	90	350	31,500	L
57	.7	Economic Report	MD	90	350	31,500	T
58	.10	Draft Report	MD	90	200	18,000	W
59	.1	Information Pamphlets	MD	90	60	5,400	D
60	.10	Final Printing	MD	90	260	23,400	W

1/ Includes 15% Contingency Allowance
MD = Man Days

TABLE A-3
PAWCATUCK RIVER - NARRAGANSETT BAY
DRAINAGE BASINS

TENTATIVE SURVEY SCHEDULE
(Monies in $1,000)

	ITEM	Allocations Thru FY 70	FY 71	FY 72	FY 73	FY 74	FY 75	TOTAL
.1	Preliminary Planning and Public Contacts	30	12	18	22	25	29	136
.2	Hydrology Studies	8	8	52	61	54	11	194
.3	Surveying & Mapping	--	--	10	24	24	--	58
.4	Materials & Foundation Investigations	--	--	20	70	65	7	162
.5	Stream Regulation	--	--	--	6	11	6	23
.6	Design & Cost Estimate	32	33	126	140	80	40	451
.7	Economics*	5	5	53	83	63	23	232
.8	Real Estate	--	--	5	12	6	--	23
.10	Preparation of Report	--	--	--	--	6	51	57
.11	Supervision and Administration	15	12	56	82	66	33	264
	TOTALS	90	70	340	500	400	200	1,600

*Includes $80,000 for flood damage survey.

PAWCATUCK RIVER & NARRAGANSETT BAY DRAINAGE BASINS INVESTIGATIONS

TENTATIVE SCHEDULE — DOLLARS X 1000

COST ACCOUNT		BAR IDENTIFICATION LETTER
.1	COORDINATION	A
	AND	B
	PUBLIC	C
	CONTACT	D
		E
.2	HYDROLOGY	F
	AND HYDRAULIC	G
.3	SURVEY	H
.4	F. AND M.	I
.5	REGULATION	J
.6	PLANNING	K
	AND	L
	DESIGN	M
	ESTIMATES	N
		O
		P
		Q
		R
.7	ECONOMICS	S
		T
		U
.8	REAL ESTATE	V
.10	REPORT	W
	PREPARATION	X
.11	S. AND A.	Y

FY-69 $20 | FY-70 $70 | FY-71 $70 | FY-72 $340 | FY-73 $500 | FY-74 $400 | FY-75 $200

RECONNAISSANCE CHECKPOINT

NEEDS CHECKPOINT

ALTERNATIVE PLANS CHECKPOINT